

2.0 REGIONAL SETTING

2.1 SURFACE FEATURES

The study area (see Figure 1-2) lies in the northwestern portion of the San Bernardino Valley at the base of the San Bernardino Mountains. The San Bernardino Valley (approximately 120 square miles in area) is comprised of a series of confluent alluvial fans derived from the San Gabriel Mountains to the northwest and the San Bernardino Mountains to the northeast. The alluvial fans are formed where the Santa Ana River, Mill, Lytle, Cajon, Devil Canyon, East Twin, and City Creeks leave the mountains and coalesce to form part of a broad alluvial plain in the central part of the San Bernardino Valley (Dutcher and Garrett 1963).

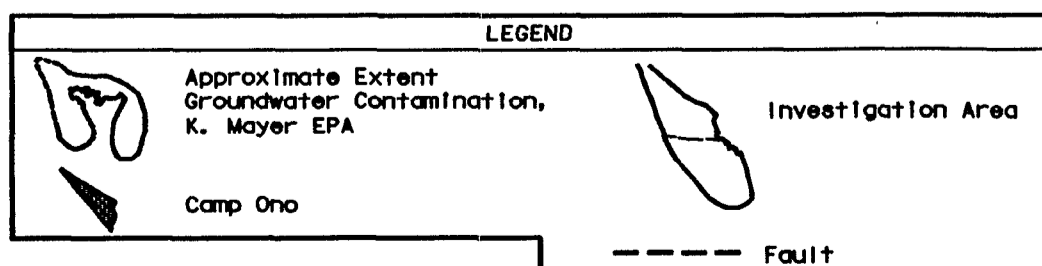
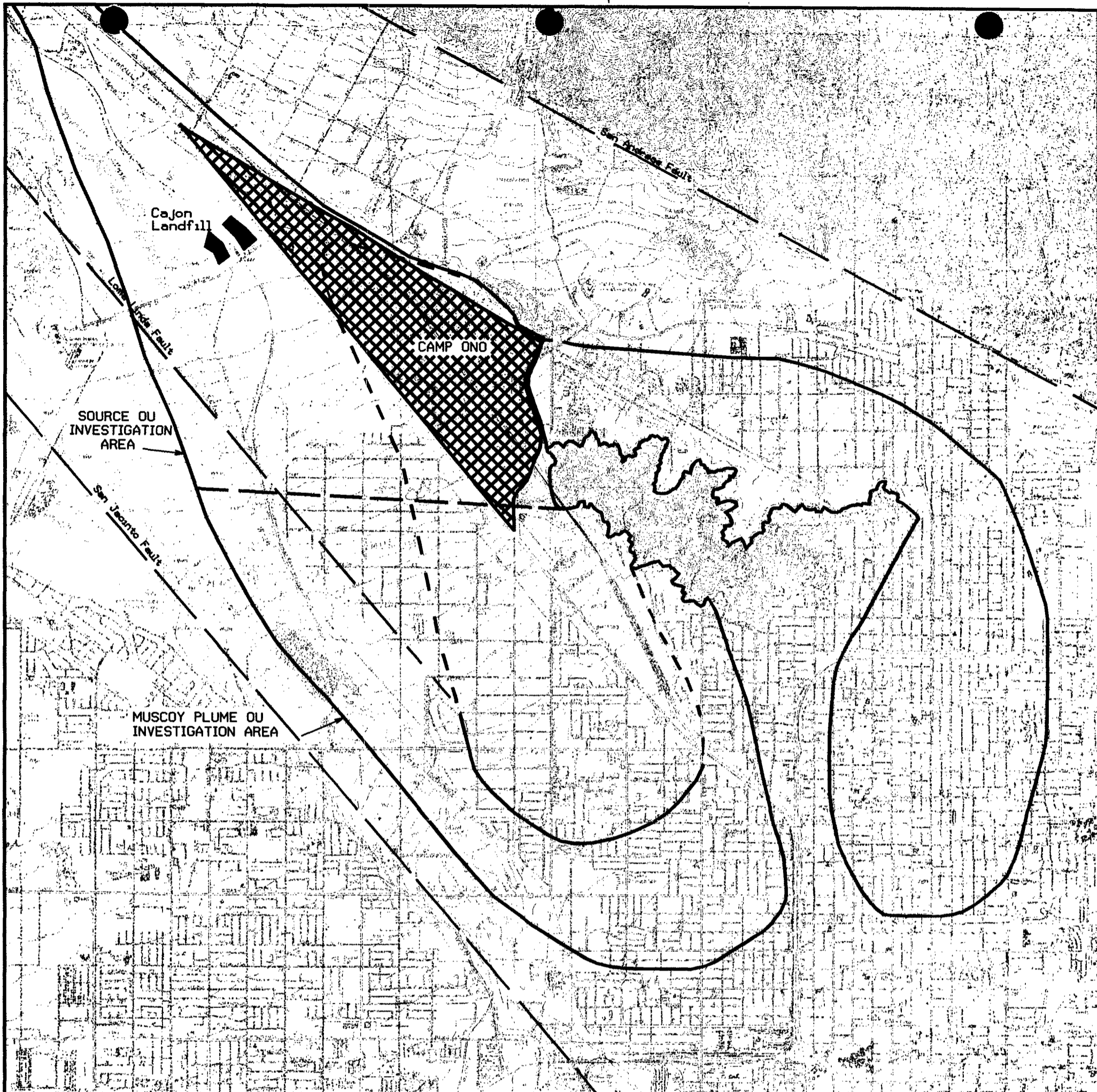
These mountains are drained by river channels and stream washes that flow southward to the valley floor. With few exceptions, area stream channels are dry washes that support sparse (or specialized) vegetation and only contain appreciable runoffs for short periods during the wet winter months.

Several bedrock hills protrude above the alluvial fans. North of the Santa Ana River, between the San Jacinto and San Andreas faults, Shandin, Perris, Badger, and Wiggins Hills rise 50 to 550 feet above the valley floor. All are believed to have been elevated by differential movement along bedrock faults (Dutcher and Garrett 1963). Well logs indicate similar bedrock hills exist at shallow depths beneath the valley floor. Several of these buried hills probably controlled deposition of the older water-bearing alluvium.

In the area northwest and west of the City of Colton, the surface of the older alluvium is concealed by relatively high hills and dunes of wind-blown sand. The hills and dunes support sparse vegetation. The crest of the dunes are as much as 40 feet above the general elevation of the alluvial plains.

Several northwestward trending faults, notably the San Andreas and San Jacinto faults, bound the San Bernardino Valley (Figure 2-1). The dissected scarp of the San Andreas fault rises above the valley edge to elevations ranging from about 2,700 feet at the mouth of Cajon Creek to more than 5,500 feet at the mouth of the Santa Ana River canyon. Ridges associated with the San Jacinto fault are some of the major structural features in southern California.

The San Jacinto fault branches from the San Andreas fault north of the study area and is the only major fault crossing the valley where topographic evidence of movement has been preserved. Scarps, terraces, and ridges are exposed along a discontinuous line from the Fontana power plant of the Southern California Edison Company near Riverside Avenue to the Santa Ana River floodplain. These landforms result from differential movement along the San Jacinto fault (Dutcher and Garrett 1963). One such landform is Bunker Hill Dike, located between the cities of San Bernardino and Colton, which consists of a series of subparallel ridges associated with the San Jacinto fault and rises 15 to 40 feet above the adjacent alluvial plain.



0 1/2 1
SCALE IN MILES

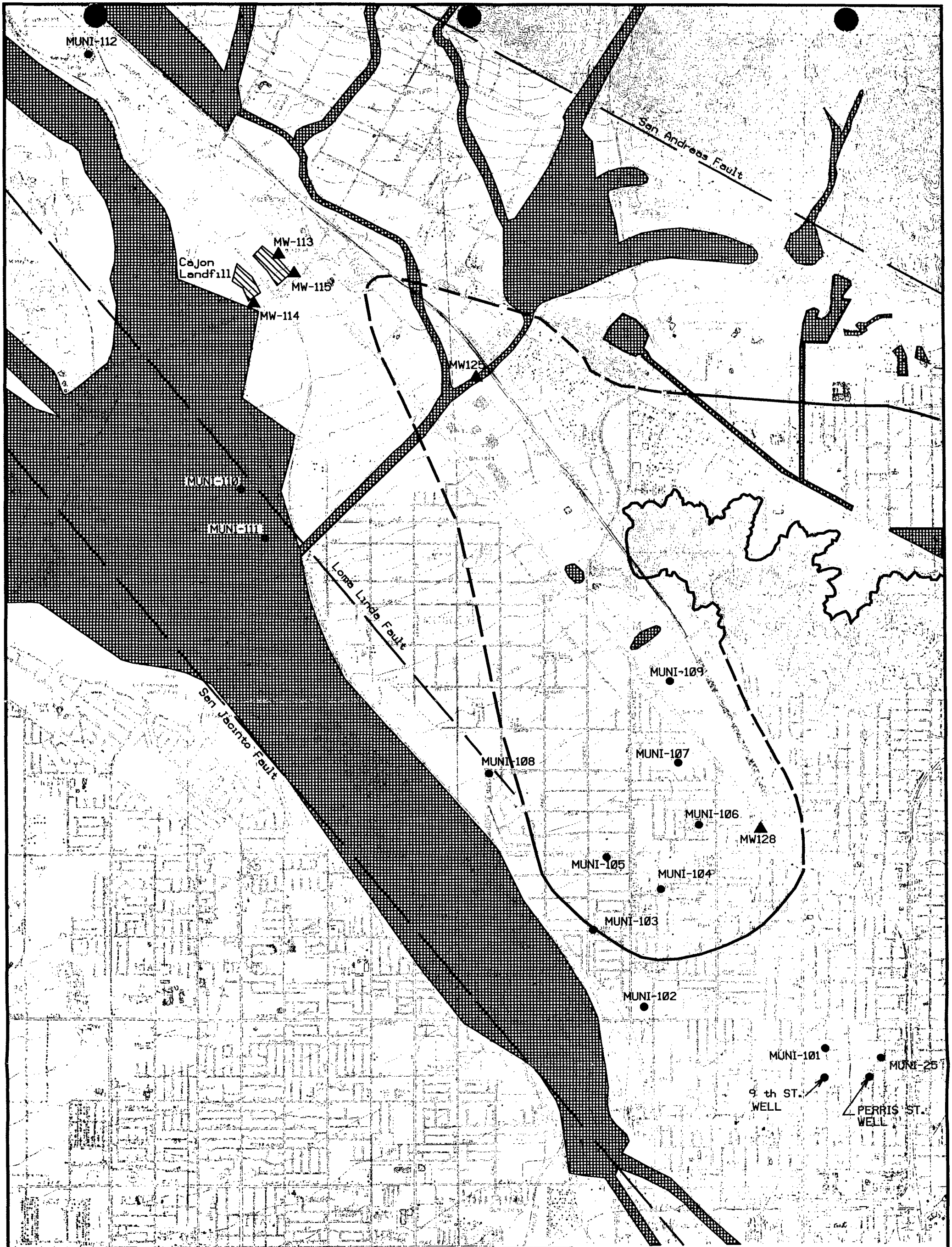


Base Map: USGS San Bernardino Quad

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MUSCOY PLUME OF RI/FS REPORT
NEWMARK GROUNDWATER CONTAMINATION SUPERFUND SITE

FIGURE 1-1
PLUME LOCATIONS



LEGEND	
	City Of San Bernardino 100-Year Flood Hazard Areas (Zone A) Source: FEMA Flood Insurance Rate Maps Panels 060281-0020B, -0010B, -0005B, 060270-7910B, -7920B, -7930B, -7940B
	Fault
	Approximate Extent Groundwater Contamination, K. Mayer EPA
	Monitoring Wells
	Municipal Supply Wells
Base Map: USGS San Bernardino Quad	
URS Consultants, Inc. Sacramento, Ca	MUSCOY PLUME OU RI/FS REPORT NEWMARK GROUNDWATER CONTAMINATION SUPERFUND SITE

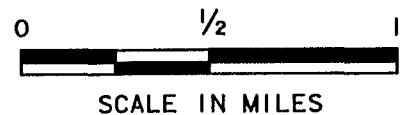


FIGURE 2-1
MUSCOY PLUME OU AREA
SURFACE FEATURES

1 Man-made features in the study area include a series of percolation basins scattered throughout the area
2 ranging in size from approximately 5,000 square feet to 20 million square feet. These basins are used
3 to provide additional groundwater recharge and substantially influence the surface water flow patterns.
4 In addition, to handle the surface water run-off from abundant residential and commercial structures,
5 concrete-lined drainage or flood canals were constructed throughout the northwest portion of the study
6 area.

7 With the exception of the Shandin and Wiggins Hills, the area slopes from the north and northwest to the
8 south. The surface elevation drops from about 1,700 feet above mean sea level (msl) in the north to
9 1,100 feet msl in the south with a declined slope of approximately 75 to 95 feet per mile (USGS San
10 Bernardino Quadrangles).

11 2.2 CLIMATE

12 The City of San Bernardino, located in the northeastern portion of the San Bernardino Valley, has a
13 mediterranean climate characterized by long, hot summers and short, mild winters. Precipitation in San
14 Bernardino averages about 19 inches per year with wide annual fluctuations. Approximately 90 % of the
15 annual rainfall occurs between November and April, with 50% of that rainfall occurring during the
16 months between December and February.

17 Average daily temperatures for the area range in the summer from the low 50s°F to the upper 90s°F,
18 with occasional temperatures above 100°F; and in the winter from the upper 30s°F to the mid-60s°F,
19 with occasional temperatures below 32°F. The sun is visible during 70-80% of the daylight hours
20 annually (Woodruff and Brock 1980).

21 Except for infrequent periods when Santa Ana winds enter the basin, the maritime air mass is dominant.
22 Periods with heavy fog are frequent; and low stratus clouds, sometimes referred to as "high fog," are a
23 characteristic climatic feature. Mean annual relative humidity is 70% at the coast and 57% inland
24 (Envicom 1989).

25 Surface winds in the study area (located in the northeast region of the 6,600 square mile South Coast Air
26 Basin) are portrayed by a diurnal reversal of direction. Breezes flow inland from the coast at
27 approximately five miles per hour (mph) during the day. The directional changes of the evening breeze
28 drain the interior land mass. The evening breezes flow from the northeast and east offshore at three to
29 four mph. This typical wind scenario is interrupted during the occurrence of the Santa Ana winds. These
30 intermittent winds are strong, very dry southerly winds that blow down from the Cajon Pass and the very
31 narrow canyons, usually for irregular periods of several days each during the fall and winter months.
32 Wind velocities for such periods can increase to over 60 mph.

33 The combination of the air basin's topography and climate create an area of severe air pollution problems.
34 The air basin's high percentage of sunlight hours produces ozone through photochemical reaction with
35 nitrogen oxides and reactive organic gases. During the summer months, dispersion of these pollutants
36 is limited by light winds and an inversion layer (a warm air mass frequently formed over the cool, moist
37 layer of air in the basin).

Federal and state health-based ambient air quality standards have been established to protect the most sensitive persons from illness or discomfort with a margin of safety: the air basin exceeds four of the state and federal ambient air quality standards for carbon monoxide, nitrogen dioxide, ozone, and fine particulate matter (PM₁₀). The air in the vicinity of San Bernardino exceeds the ambient air quality standards for ozone and PM₁₀ (SCAQMD 1989). Table 2-1 presents the most recent air quality data available.

2.3 STUDY AREA DEMOGRAPHY AND LAND USE

The study area is mainly located within the City of San Bernardino's northern and eastern city limits. However, portions of the study area extend beyond the City of San Bernardino into the City of Rialto to the west and the Cities of Colton and Loma Linda to the south. The City of San Bernardino's eastern boundary follows irregular city limits shared with San Bernardino County and the adjacent cities of Highland, Redlands, and Loma Linda (see Figure 1-2).

The California State University, San Bernardino is a major identifiable land use in the northern section of the city. The Santa Fe rail yards, also a major landmark, are located on the city's west side. Current land use at the rail yards is minimal due to recent downsizing of operations. South of the downtown area, the city is developed with commercial and industrial uses. Expansions in population and residential uses have developed outward from the downtown area with densities decreasing toward the foothills. Overall, the greatest residential densities are found adjacent to the downtown area.

Residential uses within the study area include single and multiple-family dwellings. Existing single-family densities range from less than one to seven dwelling units per acre of land. Areas containing mobile home parks and two dwelling units on a lot are also classified in this category because their character and density is consistent with what is typically thought of as single-family residential. Multiple-family residential uses encompass those areas that contain three or more dwelling units per lot and accounts for approximately one-third of the land use in the City of San Bernardino (Envicom 1989).

Commercial uses encompass neighborhood, community, or regional retail and wholesale establishments, as well as administrative offices. Commercial use accounts for approximately 4.5% of the acreage in the city. Light industrial uses include warehousing and storage, transportation and distribution of goods, light manufacturing, research and development, and other similar activities. This land use accounts for approximately 1.5% of the acreage in the city. Heavy industrial uses, such as steel fabrication, railroad uses and concrete manufacturing, account for approximately 1% of the total land acreage in the City of San Bernardino (Envicom 1989).

There are three golf courses within the city: Shandin Hills Golf course, located astride Highway 215 about one mile north of Highland Avenue; the City Municipal Golf Course, immediately north of the Santa Ana River on Waterman Avenue; and Arrowhead Country Club and Golf Course (privately owned).

Table 2-1

STATE AND FEDERAL AMBIENT AIR QUALITY STANDARDS
SAN BERNARDINO
FOURTH STREET STATION NO. 203
1990

	Ozone			Particulate Matter (PM ₁₀)		
	Standard Hour	Maximum Hourly Concentration	Days Standard Exceeded	Standard (Hour)	Maximum Hourly Concentration	Days Standard Exceeded
Federal	0.12 ppm	0.29 ppm	78	150 µg/m ³	235 µg/m ³	2
California	0.09 ppm	0.29 ppm	129	50 µg/m ³	235 µg/m ³	35

Source: California Air Resources Board. California Air Quality Data - Summary of 1990 Air Quality Data. Volume XXII. Technical Support Division.

1 Public and quasi-public uses include such facilities as schools, hospitals, government buildings, utilities,
2 and other public buildings. With the exception of two private hospitals, all are publicly owned. They
3 are all widely scattered throughout the city and its planning area. These uses occupy approximately 9%
4 of the total acreage within the city. Vacant lands include those which are undeveloped. Easements,
5 rights-of-way for highways, roads, other infrastructures facilities, and under-utilized lands are excluded.
6 Vacant land accounts for approximately one-third of the city.

7 Open space is predominantly used for, or in conjunction with, flood control uses. This land use type
8 accounts for approximately 11% of the acreage in the City. Flood control use includes a large variety
9 of facilities, such as wash areas, creeks and drainage channels, and detention and percolation basins.
10 Flood control areas are concentrated in and around the Lytle Creek Wash and Santa Ana River as they
11 pass through the city and its planning area. Four other major flood control areas are found along the
12 foothills and include the following areas: the Cable Creek area; Devil Canyon; east Twin Creek; and City
13 Creek. Cable and Devil Creek drain into Lytle Creek, while the Twin and City Creek empty into the
14 Santa Ana River. A number of other minor flood control areas contribute flood waters to these four
15 major drainages. Figure 2-1 provides an approximate delineation of the 100-year and 500-year flood
16 zones, or floodplains, in the Investigation Area. The 100-year and 500-year floods are defined as
17 streamflows with a 1% and 0.2% respective probability of occurring in any given year. The criterion
18 most often used to judge the adequacy of major flood control channels is the capacity to convey a 100-
19 year flood. None of the proposed underwater treatment facilities contained in this report are located
20 within 100-year flood hazard areas, wetlands, or riparian zones.

21 Water services provided to the communities within the study area are supplied by municipal, mutual, and
22 private water companies. The City of San Bernardino's municipal supply well system (serving a
23 population of 150,000) is the most affected by the groundwater problem (E&E 1991). Groundwater
24 supplies represent over 95% of the municipal water supply for the area. Alternative sources of drinking
25 water (e.g., water imported from northern California) are already being used at near-maximum rates but
26 represent less than 5% of the total supply. Another major supplier in the area is the City of Riverside
27 Water Department, serving a population of about 250,000. Much of the Riverside Water Department's
28 water supply comes from wells located along the Santa Ana River in the cities of San Bernardino and
29 Colton.

3.0 INVESTIGATIVE TECHNIQUES

This section describes the investigative techniques used to collect groundwater level measurements and samples and the analytical parameters used to implement the Muscoy OU Interim Sample Plan (URS 1993 a). As previously discussed, this plan covers investigations of the Newmark and Muscoy Plume OUs and the subsequently established Source OU. The objectives of the interim phase sampling which pertain to the Muscoy Plume OU include the following:

- Verify earlier data that were collected using largely undocumented sampling techniques and protocols;
- Update the location and contaminant concentrations in the Muscoy Plume OU investigation area; and
- Collect groundwater geochemical data in the Muscoy Plume OU investigation area.

The overall RI/FS objectives were presented in Section 1.1.

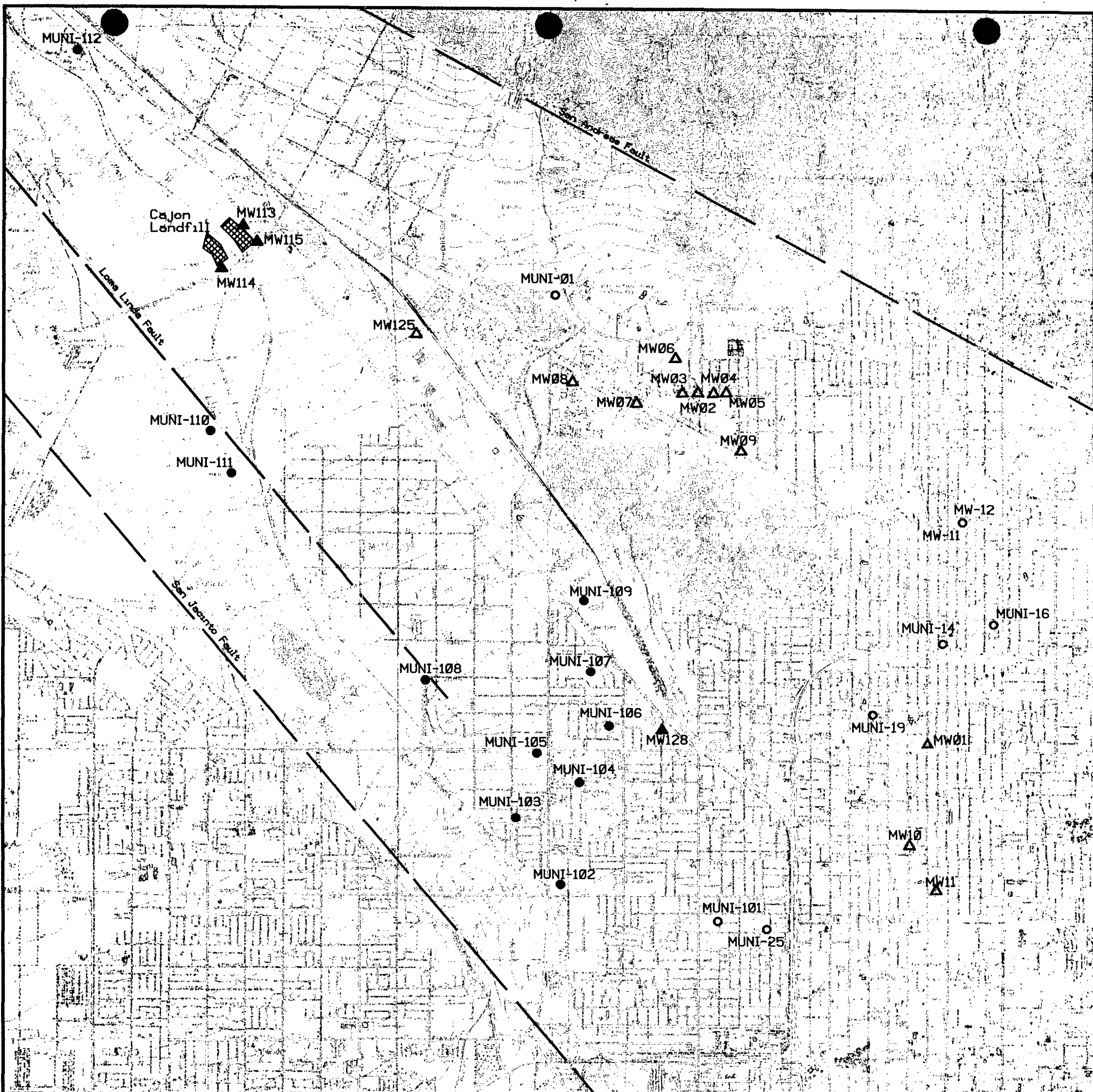
In accordance with the Interim Sampling Plan, thirty-eight municipal water supply and monitoring wells located in the Newmark, the Muscoy Plume, and the Source OUs were sounded and sampled from April 19 through May 19, 1993 (Figure 3-1). Although all the well locations in the three OUs are shown on Figure 3-1, this section of the report and the following sections which present the results of the sampling will focus on the Muscoy Plume OU only. Of the thirty-eight, ten municipal water supply wells were located within or near the Muscoy Plume OU (MUNI-101 through -109 and MUNI-25).

3.1 GROUNDWATER LEVEL MEASUREMENTS

Groundwater levels were measured and recorded prior to well purging and sampling. Levels were measured utilizing an electric water level meter or by the air-line method. Water level data are presented in Appendix 1.

Electric water level meters utilize the conductivity of water to complete an electrical current as a means to measure the water level. The current is emitted by a probe which is lowered into the well on electrical line. The electrical line is marked in footage increments. When the probe comes in contact with water, the electrical current is completed, sending a signal to the surface. The signal is an indication of the existing groundwater level within the well.

The air-line method of water level measurement involves recording the pressure the water column exerts on a submerged line after air pressure is used to push all of the water out of a submerged air line. The pressure exerted by the water column on the air within the line is equivalent to the downward pressure of the water column inside the air line. This downward pressure can be expressed in feet of water. The depth to the water surface is then calculated as the difference between the total length of the air line and the equivalent feet of water pressure necessary to evacuate the air line.



LEGEND	
Newmark OU	Muscoy OU
△ Monitoring Wells	▲ Monitoring Wells
○ Municipal Supply Wells	● Municipal Supply Wells
— Fault	
▨ Cajon Landfill (Approximate)	

0 1/2 1
SCALE IN MILES



Base Map: USGS San Bernardino Quad

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MUSCOY PLUME OU RI/FS REPORT
NEWMARK GROUNDWATER CONTAMINATION SUPERFUND SITE

FIGURE 3-1
WELL LOCATION MAP

The air-line method of groundwater level measurement was used on all active municipal supply wells. Groundwater levels from monitoring wells and all inactive, accessible, municipal supply wells were collected by the electric water level meter method. Procedures for collecting and recording the water levels are documented in the Interim Sample Plan (URS 1993a). All water level data are currently maintained on the Monitor Well Sampling Data sheets used to record well purging and groundwater parameter stabilization data. Although the water level data are not currently being stored within an electronic database system, they may be utilized in a GIS system during the long-term monitoring in accordance with sampling plan data management activities developed under the Newmark RD WA.

Water levels were collected over a five-week well sampling period. Wellhead inaccessibility and coordination with multiple local water purveyors prevented measuring water levels over a shorter time period. Each water level was measured and recorded before the well was purged and sampled. Factors which complicate water level interpretations are presented below:

- Large water level fluctuations occurring over the measurement time frame;
- Variances in screen depths below water table levels; and
- The comparability of water level data between the air-line method and the electric water level meter method.

3.2 GROUNDWATER SAMPLING

Ten municipal water supply wells (MUNI-101 through MUNI-109 and MUNI-25) located in the Muscoy Plume OU were sampled (Figure 3-1). Table 3-1 presents information associated with the municipal and monitoring well sampling. The sampling procedures used to collect groundwater samples are described below.

Arrangements for municipal water supply well sampling were made in advance with the appropriate agency or organization responsible for the operation of well. Background information including age, operating status, total depth, screened interval, pumping depth and rate, construction details, static water level, exact location, accessibility, and sampling configuration, was gathered and tabulated for each well. All available information will be maintained for future sampling events.

Groundwater measurement parameters of pH, specific conductance, temperature, and turbidity were recorded during purging and prior to sampling. Measurements were also collected during and after the removal of each well casing volume from inactive municipal and monitoring wells. Groundwater purging continued until variations in pH, specific conductance and temperature of less than 10% were recorded and turbidity readings below 25 nephelometric turbidity units (NTUs) were documented. In addition to the above criteria, a minimum of three well casing volumes were also removed from each well. As collection of the groundwater samples began, a final suite of field parameters was collected and recorded. Active municipal supply wells were purged by city personnel prior to the arrival of the groundwater sampling crew.

Table 3-1

MUNICIPAL SUPPLY WELL INFORMATION SUMMARY

Well No.	Well Name	Drilled to Bedrock	Well Diameter (in)	Total Depth (ft)	Screen Intervals (ft bgs)	Well Elevation (ft msl)	Calculated (3) Well volumes (gal)	Well Volume Pumped (gal)	New Depth to Water (ft/date)	Pumping Rate (gpm)	Age of Well (yrs)	Sampling Parameters		
												pH	Temp °C	Conductivity
Muni-25	10th & J St.	Yes	20	1215	280-1160	1110	51,882	28,050	154.0/ 4-93	2,805	27	7.8	25.1	369
Muni-101	Olive & Garner	No	20	1240	350-1050	1130.00	79,200	79,200	189.5/ 4-93	2,640	--	7.5	27.1	347
Muni-102	Baseline	No	20	580.5	126-184 224-232 262-304 312-372 468-476 540-560	1185.56	20,807	16,920	155.0/ 4-93	846	48	7.5	21.8	482
Muni-103	State Street	No	20/12	350	60-345	1222	5,500	6,055	158.58/ 5-93	50	43	7.9	22.9	488
Muni-104	19th St. #1	No	20	685	150-276 322-356 388-400 470-512 554-563 575-611 646-658	1230.3	23,206	37,500	207.5/ 4-93	1,500	42	7.1	18.8	390
Muni-105	Mt. Vernon Water Co.	No	20	598	225-308	1258.75	18,058	39,200	229.0/ 4-93	980	66	7.1	18.1	465
Muni-106	Gardena	--	12	410	135-182 197-250 306-336 370-400	1240	5,285	35,200	--	1,760	65	7.5	19.7	522

Table 3-1 (Cont'd.)

MUNICIPAL SUPPLY WELL INFORMATION SUMMARY

Well No.	Well Name	Drilled to Bedrock	Well Diameter (in)	Total Depth (ft)	Screen Intervals (ft bgs)	Well Elevation (ft msl)	Calculated (3) Well volumes (gal)	Well Volume Pumped (gal)	New Depth to Water (ft/date)	Pumping Rate (gpm)	Age of Well (yrs)	Sampling Parameters		
												pH	Temp °C	Conductivity
Muni-107	Colima	No	16	451	240-340 418-442	1275	6,201	9,030	253.0/ 5-93	43	--	7.7	23.8	557
Muni-108	Mallory #3	No	16	652	350-448 478-484 510-628	1330	13,750	16,250	652.0/ 4-93	250	35	7.4	19.7	325
Muni-109	Paperboard Co.	No	16	562	227-431	1328	8,408	8,400	293.5/ 5-93	30	43	7.7	22.9	582

-- Information unavailable

3.2.1 Municipal Supply Wells

Seven active municipal supply wells (MUNI-101, -102, -104, -105, -106, and -108) were sampled. The City of San Bernardino Municipal Water Department or Muscoy Mutual Water Company personnel assisted the URS crew during the sampling effort. These personnel assisted in obtaining static water level measurements, locating municipal supply wells, and activating the well pumps during sampling activities. Water levels were measured prior to purging and used to estimate well volumes. Each municipal supply well was purged by activating the pump for 30 minutes prior to sampling. Given the high pumping rates for these wells (1,000 to 2,000 gallons per minute), 30 minutes was deemed more than sufficient to purge three well casing volumes from each well. The total volume purged from each well was calculated using the wellhead flow meter, when available.

Prior to sample collection, a minimum of two sets of field parameters (pH, electrical conductivity, temperature, and turbidity) were measured and recorded on the URS Well Sampling Data Sheets. The aforementioned protocols for measuring groundwater parameters and purging were utilized for each municipal supply well sampled. Water samples were collected from the existing sampling spigot closest to the pump and upstream of any chemical additions. The spigot was decontaminated in accordance with the Interim Sample Plan (URS 1993a). Deviations from the Interim Sample Plan during sample collection were documented on Sample Alteration Checklists (Appendix 2). Purged water from the active municipal supply wells entered the water treatment and/or distribution system.

Three inactive municipal supply wells (MUNI-103, MUNI-107, and MUNI-109) in the Muscoy Plume OU were purged using a 4-inch submersible pump capable of pumping a minimum flow rate of 40 gallons per minute (gpm). Three well casing volumes of water were purged from the wells into a temporary on-site holding tank before being transported to the Newmark Wellfield storage tank. Field parameters were measured and recorded on URS Well Sampling Data Sheets during purging and immediately prior to sampling. After parameters stabilized, groundwater samples were collected in a 1.75-inch outside diameter Teflon® bailer that was lowered through the 2-inch diameter purge pump discharge pipe. Sampling within the discharge pipe was necessary due to the presence of an immiscible layer of turbine lubricating oil floating at the top of the water column within these wells. This condition is common in wells equipped with turbine pumps. This procedure protected the bailer from coming in contact with the pump lubricating oil each time it was lowered into the well.

After completion of sampling activities for each well, the Teflon® bailer was disassembled and decontaminated according to procedures in the Interim Sample Plan (URS 1993a). All purge water from the inactive wells was contained in a holding tank and then transported to the Newmark Wellfield.

3.3 ANALYTICAL METHODS AND DATA QUALITY EVALUATION

Sample analyses for this investigation were performed through the EPA Contract Laboratory Program (CLP) using Routine Analytical Services (RAS) and Special Analytical Services (SAS) analytical methods. Analytical methods were selected in order to: (1) verify previous investigation historic results, (2) aid in updating the location of the Muscoy plume and contaminant concentrations, and (3) collect information regarding the geochemistry in the Muscoy Plume OU to provide data that may help to trace groundwater pathways, and satisfy project analytical data quality objectives (DQOs) (e.g., detection limits, accuracy, precision and completeness).

The analytical methods selected involve a complete suite of chemical and hydrologic parameters (e.g., pesticides/PCBs, semivolatiles, drinking water volatile organic compounds (VOCs), total petroleum hydrocarbons [TPH] as gasoline and diesel, anions/cations, and other water quality parameters). Analyses were performed in accordance with the EPA guidelines through the EPA Region IX laboratory and contracted SAS laboratories using standard and modified published methods.

The analytical methods used for this investigation are discussed below.

3.3.1 RAS and SAS Methods

The RAS and SAS methods used for analysis of selected municipal supply well samples are shown in Table 3-2. RAS methods were used for samples that required CLP 3/90 Statement of Work (SOW) analyses (e.g. pesticides/PCBs, semivolatiles and total metals). SAS methods were used for specific samples that required low detection limits (e.g., drinking water volatiles) and other methods not included in the 3/90 SOW. The analytical methods and parameters used to maintain established DQOs are also presented in Table 3-2.

3.3.2 Data Quality Objectives Evaluation

During the project planning phase, overall data quality objectives (DQOs) were developed for the project. The extent of the study area, scope of the well installation, use of specific field instruments, and other items related to data collection were considered in terms of the overall project goals. During this process, the required analytical methods and DQOs for these methods were devised. The DQOs for all the groundwater samples analyzed are summarized in Table 3-3.

RAS and SAS Laboratory Adherence to Analytical DQOs

For all methods, the RAS and SAS laboratories reported data within the quantitation and detection limits. Data validation reports are presented in Appendix 3.

An evaluation of the analytical surrogate or matrix spike recovery and laboratory quality control (QC) matrix by the RAS and SAS laboratories demonstrated the following:

- Surrogates for semivolatile organics, drinking water volatile organics, total petroleum hydrocarbons (gasoline and diesel) were within the acceptable control limits except one sample for pesticide/PCBs analysis.
- The laboratory QC matrix spikes for all the organic analyses were within the established control limits requirement in the CLP SOW; and
- All matrix spike and matrix spike duplicate samples for all inorganic analyses were within the acceptable control limits.

Table 3-2
 ANALYTICAL METHODS
 MUSCOY PLUME OU WELLS

MATRIX = WATER													
CHEMISTRY TYPE	ORGANICS					INORGANICS							
SPECIFIC ANALYSES REQUESTED	RAS Pesticides/ PCBs EPA CLP SOW OLM01 0 and its revisions	RAS Semivolatiles EPA CLP SOW OLM01 0 and its revisions	SAS Drinking Water VOCs EPA Method 524.2	SAS Total Petroleum Hydrocarbons (Gasoline) LUFT 4/89 Method	SAS Total Petroleum Hydrocarbons (Diesel) LUFT 4/89 Method	RAS Total Metals EPA CLP SOW ILM02 0 and its revisions	SAS Chloride, Nitrate and Sulfate EPA Method 300.0	SAS Fluoride Standard Method 4500 F C	SAS Specific Conductance EPA Method 120.1	SAS pH EPA Method 150.1	SAS Alkalinity Carbonate, Bicarbonate and Hydroxide Standard Method 2320	SAS Total Dissolved Solids EPA Method 160.1	SAS Total Hardness EPA Method 130.2
PRESERVATIVES	Cool to 4°C		1:1 HCL to pH <2 Cool to 4°C	1:1 HCL to pH <2 Cool to 4°C	Cool to 4°C	HNO ₃ to pH <2 Cool to 4°C	Cool to 4°C				Cool to 4°C		HNO ₃ to pH <2 Cool to 4°C
TECHNICAL HOLDING TIME(S)	<7 days/40 days	<7 days/40 days	<14 days	<14 days	<14 days/40 days	<180 days <28 days Hg	<28 days NO ₃ <2 days	<28 days	<28 days	Analyze immediately	<14 days	<7 days	<180 days
CONTRACT HOLDING TIME(S)	<5 days/40 days	<5 days/40 days	<10 days	<10 days	<5 days/40 days	<180 days <26 days Hg	<25 days NO ₃ 1 day	<25 days	<25 days	Analyze immediately	<12 days	<5 days	<180 days

Table 3-3

DATA QUALITY OBJECTIVES FOR GROUNDWATER SAMPLES
 ANALYZED BY RAS AND SAS LABORATORIES

Analysis	Method ⁽¹⁾	Units ⁽²⁾	Targeted Quantitation/ Detection Limit ⁽³⁾	Accuracy ⁽⁴⁾ %	Precision ⁽⁵⁾ %	Completeness %
Pesticides/PCBs	RAS SOW for Organics Analysis OLM01.0 and its revisions	µg/l	as per CLP SOW	as per CLP SOW	as per CLP SOW	85
Semivolatile Organic Compounds	RAS SOW for Organics Analysis OLM01.0 and its revisions	µg/l	as per CLP SOW	as per CLP SOW	as per CLP SOW	85
Total Metals plus Mercury	RAS SOW for Inorganics Analysis OLM02.0 and its revisions	µg/l	as per CLP SOW	as per CLP SOW	as per CLP SOW	85
Volatile Organic Compounds	SAS Drinking Water VOCs EPA Method 524.2	µg/l	0.09-1.0	80-120 ⁽⁷⁾	-- ⁽⁸⁾	85
Total Petroleum Hydrocarbons	SAS California LUFT Manual (4/89) gasoline and diesel	mg/l	0.5	65-135	30	85
Chloride, Sulfate, Nitrate	SAS EPA Method 300.0	mg/l	1.0 0.1	85-115	20	85
Fluoride	SAS Standard Method 4500- F C	mg/l	0.1	80-120	20	85
Specific Conductance	SAS EPA Method 120.1	µmhos	--	90-110	2	85
pH	SAS EPA Method 150.1	pH Units	--	±0.05 pH units	±0.1 pH units	85

Table 3-3 (Cont'd.)

**DATA QUALITY OBJECTIVES FOR GROUNDWATER SAMPLES
 ANALYZED BY RAS AND SAS LABORATORIES**

Analysis	Method ⁽¹⁾	Units ⁽²⁾	Targeted Quantitation/ Detection Limit ⁽³⁾	Accuracy ⁽⁴⁾ %	Precision ⁽⁵⁾ %	Completeness %
Alkalinity Carbonate, Bicarbonate and Hydroxide	SAS Standard Method 2320	mg/l	2.0 ⁽⁴⁾	90-110 ⁽⁶⁾	20	85
Total Dissolved Solids	SAS EPA Method 160.1	mg/l	10.0	85-115 ⁽⁶⁾	2	85
Total Hardness	SAS EPA Method 130.2	mg/l	5.0	85-115 ⁽⁶⁾	20	85

- (1) Methods for analyses were obtained from EPA 1983, 1988b, 1989b, 1990a, 1990b; LUFT 1989.
 (2) Units reported in mass/volume unless otherwise indicated.
 (3) Derived from laboratory reporting limits. TPH laboratory attainable limited derived from RWQCB 1990.
 (4) Derived from laboratory attainable control limits through analytical surrogate or matrix spike recovery and laboratory QC.
 (5) Derived from laboratory relative % difference between results of field replicate samples or through matrix duplicates.
 (6) Value derived from QC reference sample.
 (7) Derived from a sample laboratory fortified blank (LFB), containing each analyte of interest at a concentration in the range of 0.2-5 µg/l.
 (8) Precision is not calculated because this analysis utilizes only a single LFB.

- 1 The data results for the environmental samples associated with the matrix spikes are valid and usable.
- 2 Precision for pesticide/PCBs, semivolatile organics, and total petroleum hydrocarbons (gasoline and
- 3 diesel) analyses was not calculated because duplicate pair samples did not show any detections.
- 4 Calculated precision for target analytes were detected greater than the Contract Required Detection Limit.
- 5 The duplicate sample collected from well MW08B showed precision results outside the acceptance criteria
- 6 for aluminum, barium, calcium, magnesium, and zinc.
- 7 The data quality objectives for completeness were met.